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Dated 5 October 2004

For the Department of Trade and Industry

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Your reference **Caching Content (UK)**

0321674.4

The **Patent Office**

Request for grant of a Patent

Form 1/77 Patents Act 1977

1 Title of Invention

Caching content on phones

2. Applicant's details

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4 Reference Number

Caching Content (UK)

5 Claiming an earlier application date

An earlier filing date is claimed:

Yes ☐ No ☒

Number of earlier application or patent number

Filing date

15 (4) (Divisional) ☐ 8(3) ☐ 12(6) ☐ 37(4) ☐

6 Declaration of priority

Country of filing	Priority Application Number	Filing Date

7 Inventorship

The applicant(s) are the sole inventors/joint inventors

Yes ☐ No ☒

8 Checklist

		Continuation sheets	
Claims	0	Description	5
Abstract	0	Drawings	0

Priority Documents	~~Yes~~/No
Translations of Priority Documents	~~Yes~~/No
Patents Form 7/77	~~Yes~~/No
Patents Form 9/77	~~Yes~~/No
Patents Form 10/77	~~Yes~~/No

9 Request

We request the grant of a patent on the basis of this application

Signed: Origin Limited Date: 16 September 2003

(Origin Limited)

Caching content on phones

August 18th 2003

Introduction

With current technology content (for example WAP or Web pages) can be cached on a phone for a given period of time. This time is set by the content creator – when it expires the browser is forced to reload the page from the WAP or internet site.

In order to improve the user experience, it is desirable to cache the content pre-emptively on subscribers' phones. For example, this removes the need for the browser to download WAP pages from the Internet, because they are already cached locally on the phone.

However with no feedback about what content a given user is looking at on the phone, there is currently no way to make intelligent decisions about what content should be cached for a particular user.

Cognima changes this. Cognima has already developed and shown its Dynamic Service Directory (DSD) where content is pre-emptively loaded onto a phone so that a user can view it instantly.

What has not been shown publicly, and what is the basis of this invention, is that because Cognima is a two-way replication technology the cached pages that are being viewed by the user can be logged locally on the phone and that information replicated back to the Cognima Server. With this information, and knowledge of how fast a given WAP site is changing, the Cognima Server can make intelligent decisions about whether it is worth pre-emptively caching particular content on a given user's phone.

How it works

Cognima's new proposed DSD will measure what content is viewed on the phone and will log the time the user viewed it. Using Cognima's replication technology this logging information will be replicated back to the Cognima Server.

At the Cognima Server there are a set of WAP or Internet sites that the server has been instructed to look at. The server periodically reads these sites to see if the content on the site has changed. So the Server knows how fast and at what times the content on a given site changes. This could also be achieved by closer integration with a content site where a direct XML feed is sent to the Cognima Server, allowing the Cognima Server to be notified when a site changes.

Given these two measurements, when a site is updated the Cognima Server can calculate, on a per-user basis, if it is worth sending the data for the updated site to be pre-emptively cached on the phone. The following conditions would be taken into account for this calculation:

- How fast the site is changing – if the site changes much faster than users will typically access it, pre-emptive caching might make no sense (e.g. ball-by-ball cricket updates)
- How often the user views a given site – if they never look at it then the site is not worth caching
- What time of day it is – if we are in an off-peak GPRS time it may be less costly to transfer pages from the site to the phone

- What day of the week it is – by measuring user activity over weeks or months, usage patterns can be deduced such that maybe a user is only likely to view a certain site on a weekend

- What the Operator wants to promote – they may have a certain site or sites they want to cache to make them more likely to be viewed

For all sites, or on a site-by-site basis, the Operator can set thresholds for all of the above conditions – and if all these thresholds are met the site is then pre-emptively cached on the phone. These thresholds are controlled at the server and so can be updated at any point by the Operator if they want to implement different caching strategies.

The key point is that without the user activity logging that is replicated back from the phone none of these calculations can be sensibly made on a per-user basis. With this system the content cached on a given phone is completely optimised for that user and no-one else.

User hints

Once the site has been cached on the phone it is possible to set up an API which allows the User Interface (UI) that displays the set of content links to be informed that a certain bit of content is or is not cached on the phone. The UI can then be changed in some way to show that a given site is cached and therefore that the user will get an "instant" viewing experience if they click on that link.

Another way this system could be implemented with no UI changes of the phone is to set up a set a locally cached menu of services which refer to locally cached pages on the phone – these would either contain the cache content or redirect the users to the external site if the site was not cached.

This allows content to be put pre-emptively on a phone on the basis that because it is instantly available a user will be more likely to click on it. Cognima allows such a hypothesis to be tested using the stats function described below.

This principle is covered in part by the Now! Concept in a document called "DSD presentation" written by Mark Stalker on 11/7/2003.

Measuring how the system works

Cognima replicates back to the user logging information about what sites are being viewed – one extra bit of information that can be included is whether the site that the user views was cached on the phone or not. This data can be used to produce some very interesting stats for Cognima's customers:

- The number of cached sites that were viewed. This translates directly to how much the user experience for the user was improved. Knowing the average download time of a site this could also translate directly into the number of minutes of waiting time the user has been saved.

- Knowing the cached sites that have been viewed it is possible to work out how much bandwidth (and this could be split into peak and off-peak bandwidth) has been saved by the Operator – i.e. when the user views a cached site the download of that data has been saved. As Cognima pre-emptively cached the site on the phone in the first place it knows exactly how much data the transfer of the site would have taken.

Depending on the caching strategy chosen by the Operator the overall bandwidth usage may actually increase, because some pages may be downloaded to users who never look at them. However the DSD system will move the majority of this data traffic from peak to off-peak periods, filling bandwidth troughs

and reducing peaks, and so the marginal cost of transferring this data is close to zero. Peak bandwidth is saved because users no longer need to download WAP pages in real-time during peak hours; the pages will have been cached in advance on their phones during the preceding off-peak period.

These figures are more than just interesting information for Network Operators. New caching strategies can be tried out and the effect on both the customer experience and the bandwidth used can be measured.

Cache expiration

Because the Cognima server knows how often a site is updated (and this may change depending on the time of day or day of the week) it can make a calculation of how long the cached data on the phone should stay cached before the data is removed and the phone goes back to using normal WAP or Website download.

For example if a site changes only once a day at 4pm generally then when the content is cached on the phone this system will assign an expiration time of 4pm the following day for that site.

It is also possible for the Cognima Server to examine a site and see that a site has not been updated and so it can extend the cache expiry time for the cached content on a phone by replicating just that information to the phone. In this case the content is already on the phone and so there is no need to download it to the phone again and so more bandwidth has been saved.

User Scenario

A typical user scenario for DSD is outlined below:

- The Operator wishes to promote a new teen WAP site that updates daily
- Cognima DSD caches all or part of the WAP site in advance on phones belonging to subscribers within the target market segment
- A menu update is sent to these subscribers' phones, creating a WAP link in the top-level phone menu
- When a subscriber clicks on the new link in the phone menu, the phone's WAP browser is launched and instantly displays pages from the local cached copy of the WAP site
- If the subscriber follows a link to a page that has not been cached, the browser connects via WAP to the Internet and downloads the page to the phone as for any normal WAP page
- WAP site updates are cached nightly on subscribers' phones (if a subscriber's phone is switched off throughout the update period, then the cache will expire); each morning, subscribers will get instant access on their phones to the latest version of the WAP site
- Whenever subscribers access cached WAP pages on the phone, Cognima records their actions in usage logs that are replicated back to the server on a daily basis using off-peak bandwidth
- After a few days, the Cognima Server stops caching WAP pages for those subscribers that have shown little interest in accessing the site; the precise rules for this can be defined by the Operator
- After a few weeks, the Operator ends its promotion of the WAP site and removes the link from the main menu on subscribers' phones

- However, the Operator continues to cache the site for heavy users, and may even deliver them a custom menu so that the WAP link remains available.

Caching Strategies

With this system a number of caching strategies are possible ranging from simple models to ones involving prediction of exactly when a site might change and calculation of the cost/benefit of caching the site. A few of the simpler examples are shown below. Because this system would potentially modify user behaviour the only way to be certain which one would be the best would be to test it on real users.

Simple daily update

In this model the idea is that a set of cached sites are updated overnight using off-peak bandwidth. The decision about what to cache is made on the basis that a site is only worth caching if:

1. The user accesses the site quite frequently
AND
2. The site does not change too often

On the server the operator sets two thresholds:

Ta = minimum number of times a user needs to access a given site per week
Tc = maximum number of times a given site can change per week

so if the user has the following usage;

a = no of times user access a given site per week
c = no of times given site changes per week

then the site would only be cached if:

$(a > Ta)$ AND $(c < Tc)$

Fixed cached allocation

In this strategy some cached sites are updated overnight, some every few days overnight, but even fast changing sites are cached on the phone.

The hypothesis here is that even though the site changes every hour or so (e.g. a new headline appears) the user is still interested in browsing news-headlines that are up to a day old. For slower changing content like features and reviews, then users could be interested in things that are up to a week old.

So for example the news headlines are cached over-night, and an on-line magazine is updated overnight every few days. Crucially the preemptively cached content is the teaser (or advert) which drives people to connect in order to get the full story.

This principle is also covered by the Jumpl Concept in a document called "DSD presentation" written by Mark Stalker on 11/7/2003.

One way to do this would be to decide what volume of data you want to put on the phone and cache a standard selection of content. Once the data is cached, if the user hasn't looked at it for more than a week or two, it is removed. This frees up a slot for some new content. Since the Cognima Server keeps track of

what a user looks at, it can tag content and offer new content that the user may be interested in based on what they look at most often.

In this way the selection of cached content starts off generic and gradually evolves towards their personal set of interests.

www.cognima.com